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(54) Self -bonding Composite Sheeting for Prevention and Patching of Cracks Especially in Asphalt and Concrete Surfaces.

(57) Self -bonding composite sheeting for prevention and patching of cracks especially in asphalt and concrete surfaces in highway and waterworks. The composite is built from a reinforcement sheet utilizing high module fibers and a thermoplastic non-woven fabric or web which are joined together by means of an elastic bonding means, in such a manner that the non-woven fabric or web, together with the bonding means, is wider than the reinforcement sheet and extends over both sides of it.

Self -bonding Composite Sheeting for Prevention and Patching of Cracks Especially in Asphalt and Concrete Surfaces

The invention relates to a self-bonding composite sheeting for the prevention and patching of cracks especially in asphalt and concrete surfaces in highways and waterworks, consisting of a reinforcement sheet utilizing high module fibers and a thermoplastic non-woven fabric or web which are joined together by means of an elastomeric bonding means.

The repair of cracks in roadways or as the case may be between roadway sections, for example between individual concrete roadway slabs, is accomplished at present by filling the crack with bitumen which is then, after applying a bituminous binding material or as the case may be a spray, covered by one or more asphalt layers. As a result of subsequent stress, and depending on intensity of the load, sooner or later the same crack reappears and usually, quite soon thereafter, the roadway has to be repaired again. Previous attempts have failed to avoid this limitation. So, for example, after filling the cracks, or as the case may be, potholes, a fabric or mesh made from thermoplastic fibers, or a bitumen-impregnated or coated thermoplastic fabric, is applied as an intermediate layer over the entire surface to be repaired and on top of that a new asphalt outer cover is applied. This provides only limited protection and crack propagation at the superstructure of the extreme expansion joints or cracks is only postponed. As a consequence of the higher expansion of thermoplastic sheeting, that is on the average more than 10% higher, stress produces new cracks in the roadway skin.

In order to eliminate this disadvantage meshes made from glass fibers have been utilized in an attempt to reinforce or bridge over cracked roadway superstructures. In this manner, the filled-up crack is covered with the glass mesh and the asphalt is applied on top of that. Based on the lower expansion of the glass fibers which is approximately equivalent - in the one in a thousand range - to that of the asphalt the glass fiber mesh this can indeed prevent a new breakthrough of the covered-up cracks and thus, in the region of the original cracks, reinforcement can be achieved. A serious disadvantage however arises in that the lattice structure of the glass fiber mesh is quite soon visibly penetrated as a result of traffic stress and particularly at the and of the mesh, new cracks, so-called secondary cracks, develop.

The object of the present invention is to prevent the formation of cracks in asphalt and concrete surfaces and to permanently patch those cracks that already exist.

The solution to the problem can be realized with the help of a composite sheeting consisting of a reinforcement sheet made from strengthening fibers and a fabric or web made from thermoplastic fibers which are embedded in an elastomeric self-bonding adhesive material.

The object of the invention accordingly is a self-bonding composite sheeting for prevention and repair of cracks especially in asphalt and concrete surfaces in roads and

waterworks, consisting of a sheet-like reinforcement utilizing high module fibers and a thermoplastic non-woven fabric or web which are joined together by means of an elastic bonding means, wherein the reinforcement sheeting is completely embedded in the adhesive material and the fabric or web are only partly embedded, and the fabric or web together with the adhesive means is wider than the reinforcement sheeting and extends on both the left and right sides over the reinforcement sheeting; the adhesive material can if necessary be covered by a protective film.

The flat reinforcement sheeting utilized in the composite sheeting can for example be in the form of a web or mesh. Structures fabricated from high module fibers are preferred that are fixed at the point of intersection, for example by an adhesive or by interweaving the fibers at their intersecting points. For the reinforcement sheeting, practically any known strengthening fibers, such as glass, graphite, aramid, ceramic or metal phases or fibers of polyether ketone (PEEK) can be utilized, with glass, graphite, aramid or PEEK fibers being preferred.

The fabric or web utilized in the composite sheeting consists of thermoplastic fibers , such as polypropylene, polyethylene, polyester or polyamide. Polypropylene fibers are especially preferred. As fabric, in addition to non-woven felts or fabrics, staple fiber fabrics may be used, non-woven felts being preferred. The fabric or web preferably have up to half of their thickness and especially up to two thirds of their thickness as adhesion material embedded therein. It is further preferred that the fabric or web with the adhesive material extends over both the left and right of the composite sheeting, and at least 5 cm over the reinforcement sheeting.

The adhesion means utilized in the composite sheeting consists preferably of bitumen, but can if necessary may be modified with polymers based for example on styrene, butadiene, butene, ethylene propylene diamine (EPDM), acrylonitrile or ataxic polypropylene. Preferred adhesive materials are those based on styrene, butadiene, butene, EPDM, acrylonitrile and ataxic polypropylene. The adhesive material can if necessary be thinned with organic solvents.

Depending on the expected stresses the composite sheetings preferably have, according to the invention, an area weight of 1000 to 3500 g/m^2. The area weight of the fabric or web is usually in a range from 100 to 1000 g/m^2 and that of the reinforcement sheetings is between 50 to 5000 g/m^2.

According to the invention, the formation of cracks can be prevented with the help of the composite sheeting for example by crossing over to different parts of the roadway, for example the joints between concrete slabs, joints between the two roadway sides or, in the cross-over region to a bridge. The composite sheeting is also suitable for patching larger cavities, flangeways, potholes caused by frost or other uneven areas in the roadway. Another important application is to cover the seams of graves after their excavation is completed. There is also the possibility of patching, and precautionary caulking, of cracks in dams and canal work, for example in irrigation canals.

For patching and crack prevention of surfaces for example a joint may be filled with a bituminous mass filler material or the crack can be covered with the composite sheeting according to the invention in such a way that the self-bonding adhesive material lies over the surface to be protected. For smaller cracks a 50 cm wide composite sheeting is unrolled over the crack. For wider cracks, holes or uneven sections correspondingly wider sheeting is laid down. Finally a spray material for example of a bitumen emulsion is applied uniformly onto the entire surface to be protected. The absorbing capacity of the surface of the composite sheeting for the spray material must be of the same magnitude as used for the adjoining surface to be patched. This will be accomplished so that the felt or web of the composite sheeting is embedded to about the same depth in adhesive material. If a large portion of the felt or web is exposed, then the capacity for sprayed material becomes correspondingly larger than if it is embedded deeper. In road construction usually about 0.2 to 0.5 kg/m^2 of sprayed on material is applied. Finally, the patched surface is usually built up with an asphalt/concrete coating that, depending on the expected loading, is about 2-10 cm in thickness.

In addition to the outstanding and long-lasting reinforcement that is possible with the composite sheeting according to the invention, it can be accomplished very simply and rapidly and which and causes very little traffic delay, it also does not give rise to secondary cracks. There is also the advantage that on the basis of the special construction only the region of a seam or crack needs to be covered up and not the entire surface so that the material usage is significantly lower. It is moreover possible to build up the composite sheeting with thinner thickness layers. As a result of the self-adhesive characteristic it is possible to avid extensive weather-related delays, resulting from the fact that the superstructure can be applied immediately after laying down the composite sheeting onto the clean and dry surface in the area of the crack.

The advantageous working of the composite sheeting is based primarily on the fact that in the central zone it is reinforcing and in the edge zones there is redistribution of the stress. Stress redistribution arises from the higher lateral extension of the fabric or web impregnated with binder material over the reinforcement sheet. Movements, or as the case may be, stress concentrations are thus dissipated in the region of the composite sheeting and are not transmitted to the overlaying layers. The protected and patched areas are thus protected in this manner from stress and coercive force.

Fabrication of the composite sheeting according to the invention is carried out by the unilateral impregnation of the reinforcement sheeting and the fabric or web with molten adhesive material. Thereby, for example, two sheetings can run in tandem over the dipping rollers into the molten adhesive material, or the sheetings can pass from above through a dosing apparatus having a nozzle or a doctor blade and become impregnated with the molten adhesive such that the top side of the reinforcement sheeting is totally impregnated while the underlying fabric or web is not impregnated through its entire thickness. Another option is to impregnate the sheets separately from each other

bringing them together only at the end. Finally the composite sheeting is mangled and cooled.

Example 1:

An 0.3 m wide structure made from glass fibers (180 g/m^2; SD 6510 K. Virtulan, Germany) together with an 0.5 m wide, 1.5 mm thick and 140 g/m^2 weight polypropylene-non-woven fabric (Polyfelt ® PGM 14) was impregnated with a 150 °C melt of SBS-modified bitumen (Dörrkuplast, Dörr, Austria) and mangled so that the fabric was 1 mm deep in bitumen. Finally the resulting composite sheeting was solidified by cooling and the bitumen covered with an 0.03 mm polyethylene separating foil (Fepla-Hirsch).

Example 2:

A composite sheeting analogous to Example 1 was prepared wherein however a glass fiber structure of 205 g/m^2 (SD 8810 K53) was utilized.

Example 3:

In order to demonstrate the superior performance of composite sheeting according to the invention, a traffic load test was simulated. Onto a 50 mm thick circular rubber base 2.5 m in diameter a 25 mm thick asphalt layer was applied and across the diameter two perpendicularly standing 3 mm wide, 25 mm deep grooves were cut in order to simulate a crack. One of the grooves was covered with an 0.5 m wide composite sheeting according to Example 1, the other groove was covered with a composite sheeting that in contrast to that in Example 1 had a glass fiber structure and also a polypropylene web 0.5 m wide. Finally, it was pre-sprayed with a bitumen emulsion, and covered with a 50 mm thick asphalt layer. This asphalt sheeting as rotated on a carousel having a diameter of 1.5 m, and two rubber wheels, having a diameter of 225 mm and a width of 85 mm, each one being loaded to 1.85 kN, were mounted opposite each other on a rotating jig. The number of revolutions of the wheel assembly on the patched asphalt sheeting according to the invention was 25 per minute. The crack not repaired according to the invention penetrated the asphalt covering as a secondary crack after 5540 revolutions (corresponding to 113080 loadings). The crack repaired according to the invention developed a central crack through the asphalt only after 91250 revolutions(corresponding to 182500 loadings)

Claims

1. A self-bonding composite sheeting for prevention and repair of cracks especially in asphalt and concrete sheets in roadways and waterworks, consisting of a sheet-like reinforcement sheet utilizing high module fibers and a thermoplastic non-woven fabric or web which are joined together by means of an elastomeric, self-adhesive bonding

material, the reinforcement sheeting being completely embedded in the binder material and the fabric or web only partly, characterized in that the fabric or web is wider than the reinforcement sheeting and extends on both the left and the right hand sides beyond the reinforcement sheeting, with the binding material being, if necessary, covered with a protective film.

2. Composite sheeting according to Claim 1, characterized in that the binding material consists of bitumen, that if necessary is modified with polymers based on styrene, butadiene, butene, EPDM, acrylonitrile, or ataxic polypropylene

3. Composite sheeting according to Claim 1, characterized in that the binding material consists of a polymer based on styrene, butadiene, butene, EPDM, acrylonitrile, or ataxic polypropylene.

4. Composite sheeting according to one of claims 1 to 3, characterized in that the reinforcement sheeting consists of a fiber structure.

5. Composite sheeting according to one of claims 1 to 4, characterized in that the high module fibers of the reinforcement sheeting consists of glass, graphite, aramid, or polyether ketone.

6. Composite sheeting according to one of claims 1 to 5, characterized in that the fabric or web consists of polypropylene, polyethylene, polyester or polyamide fibers.

7. Composite sheeting according to one of claims 1 to 6, characterized in that the fabric or web is embedded up to half its thickness in the adhesive material.

8. Composite sheeting according to one of claims 1 to 7, characterized in that the fabric or web with the binding material extends both left and right 5 cm over the reinforcement sheeting.

9. Composite sheeting according to one of claims 1 to 7, characterized in that the web consists of non-woven fibers.

10. Process for preventing and patching cracks especially in asphalt and concrete surfaces, characterized in that a crack or a seam, or as the case may be, a crossover between two roadway constructions is covered with the composite sheeting according to Claim 1, filled with filling material, the entire protected or repaired surface being covered, wherein the superstructures or coverings, as the case may be, of the protected or repaired surface are free from stress.

European Patent Office

EUROPEAN RESEARCH REPORT

Application Number

EP 89 10 8007

PERTINENT DOCUMENTS

Category	Identity of Documents and Specification of Relevant Sections	Concerned Claims	CLASSIFICATION OF APPLICATION (Int Cl[4])
A	US-A-4,440,816 (UFFNER) "Claims 1, 20, 26, 27"	1, 2, 5	B3285/28 B3285/26 B32819/06
A	US-A-4,508,770 (MUNCASTER et al) "The entire document"	1, 5	B32827/02 E01C11/16
A	EP-A-199827 (BAY MILLS Ltd) "Claims 1-4"	1, 5	
A	FR-A-2193711 (AKTIESELSKABET JENS VILLADSENS FABRIKER) "Claim 1"	1, 5	
A	GB-A-1394997 (RUBEROID Ltd) "Page 1, Lines 12-64"	1, 2, 5, 6	
A	US-A-4,368,228 (GORGATI) "Claim 1"	1, 5, 6	
A	US-A-3,210,902 (W. G. CRAIG)	1	
			SUBJECT AREAS RESEARCHED (Int.Cl.[4]) B32B E01C

The present research report was drawn up for all patent claims

Research Location	Publication Date of Research	Author
THE HAGUE	Oct. 31, 1990	IBARROLA TORRES O

DOCUMENT CATEGORIES

A: Technological Background